

A note on the occurrence of elvers *Anguilla anguilla* in a stream on the Ross of Mull Scotland over a two year period (2006-2007)

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ABSTRACT

During the course of field work in Scotland between 2006 and 2007 the numbers of elvers within the substrate of a small coastal stream were estimated by sub-sampling using an FBA hand net. The total numbers of elvers caught over a three-day period in 2006 and 2007 were 139 and 396 respectively. These catches were equivalent to population densities of between 266.9 and 740.9 per 100m² of stream bed depending on the method employed to calculate density. Average catch rates varied from 0.15 up to a maximum of 0.5 per sample. Although trivial in size compared to data derived from commercial fisheries there are no data currently available for migratory elvers on the west coast of Scotland. Given the current demise of eels across Europe it is suggested that similar methods could usefully be employed more widely across Scotland to monitor the status of eel stocks.

INTRODUCTION

Until recently, the eel *Anguilla anguilla* was one of the commonest species of freshwater fish found in the UK and north west Europe (de Nie, 1988; Maitland, 2003, 2007; Maitland & Campbell, 1992; Maitland & Adams, 2007, Tesch, 2003). However, since the late 1970s and early 1980s there has been a marked decline both in the yields of 'adult' fish to freshwater fisheries and to those of the more lucrative elver fisheries (Arai *et al.*, 2006; Davies *et al.*, 2004; Dekker, 2003, 2004; Palstra, 2006; ICES, 1998). Losses have been particularly acute (more than 80% decline in annual yields) in Lough Neagh, Northern Ireland since the late 1960s (C. Harrod, personal communication). Although reasons for these trends remain unclear, various monitoring sites have been established on rivers to the south of England to monitor this problem (leading to Action Plans), but as far as we are aware there are no monitoring facilities for elvers or any other life-history stages, currently in place in Scotland (SEPA, J. Godfrey, personal communication). Similarly, given the difficulties of predicting eel numbers by traditional stock and recruitment models there is an urgent need to establish alternative monitoring techniques (Creutzberg, 1961; Gomez-Mourelo, 2005; Ciccotti *et al.*, 1995).

During the course of general survey work on Mull we attempted to estimate the numbers of elvers entering a small stream on the Ross of Mull during the spring 'migratory' period. In this study we present the results of counts made in 2006 and 2007, which seem to confirm the 'recruitment' of elvers to this site.

MATERIALS AND METHODS

The sampled stream (Fig. 1) is situated to the west of the Ross of Mull close to the small 'township' of Fidden (Ordnance Survey NM 31053: 21281). The stream enters the sea via a small estuary (An Caolas) to the west and is bounded on both sides by salt marsh. Some of the connecting streams drain from Loch Poit, which used to be the source of drinking water for Fionnphort. Samples were taken over three days during May 2006 and 2007 at low tide or at the start of the flood tide. Samples were made using a standard Freshwater Biological Association pond net (Fig. 2) worked upstream in the sediments over an area of about 0.5 m². Each site was initially marked out with a grid using ranging poles and tape measures.

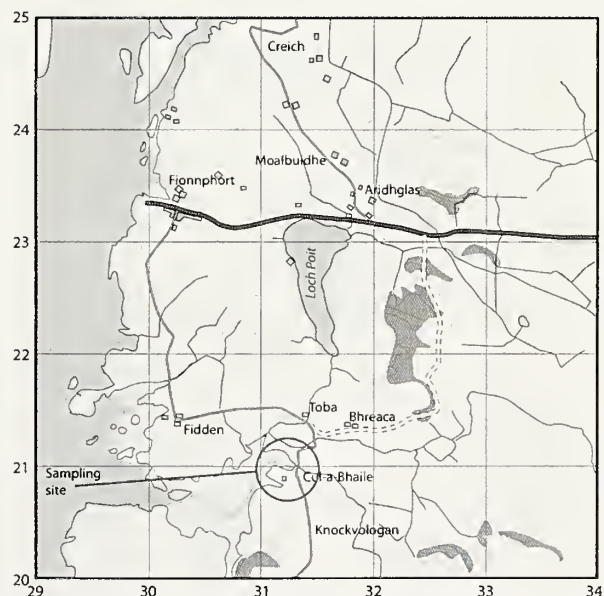


Fig. 1. Location of the stream on the Ross of Mull close to Fidden. Sampling site 1 is to the west of the circle and sample site 4 to the east. Grid lines = 1km © Crown Copyright/database right 2008. An Ordnance Survey/EDINA supplied service.



Fig. 2. Sampling elvers on the Ross of Mull using FBA nets – site 4.

All elvers were removed and measured for length to the nearest 0.5 cm below and allocated to one of three colour classes (transparent, partially pigmented and fully pigmented). Estimates of population density were made first, by multiplying up numbers by area of sub-sample (to 100m²) and secondly by methods based on decline in catch per unit effort (CPUE) over three sampling occasions (Seber & LeCren, 1967). During the removal study, all animals were retained in a 100 litre container until the end of sampling period and then returned unharmed to the stream at the end of the study. Unfortunately, only one sample site (number four) could be examined in 2007 because of heavy rains and flash floods. The sampling effort in 2007 (two people) was fixed at three hours. The sediment composition varied from fine silt up to large stones in the upstream section. Site one is estuarine; site four is upstream and largely freshwater.

RESULTS

The total numbers of elvers caught in 2006 and 2007 were 139 and 396 respectively. Individual catch ‘rates’ varied from 0.1512 per sample up to a maximum of 0.5016 (Table 1). When multiplied up these values were equivalent to population densities of between 151 and 362 per 100m² for the four sample sites in 2006. Data for 2007 are not fully comparable as they refer to only one site, site 4.

Year	Site	CPUE	Number of samples	Population size
2006	1	0.3623	138	362.3
2006	2	0.2609	138	260.9
2006	3	0.1512	172	151.2
2006	4	0.2935	92	293.2
Mean				266.9
2007	4 (a)	0.3761	327	109.3
2007	4 (b)	0.3070	342	93.3
2007	4 (c)	0.5016	319	142.2
Total				344.8

Table 1. Average values for catch per unit effort (CPUE) of elvers caught during the Spring of 2006 and 2007 by hand net (FBA) together with estimates of

population size per 100m² of stream. For 2007 the same site was sampled on three consecutive days (a-c). Site one is downstream and tidal whereas site four is upstream and largely freshwater (see Figs. 1 and 2). All elvers were retained until the end of the sampling period in both years.

When the four sample sites were re-sampled over three days in 2006, the mean total numbers had declined to values of 157.5 and 119.2 respectively. These values were equivalent to total population estimates of between 651.06 and 740.9 per 100m² (Seber & LeCren and by regression, respectively). If the catches for 2007 are summed (site 4) over three days the total population estimate would be 344.8 elvers per 100m² (see Discussion).

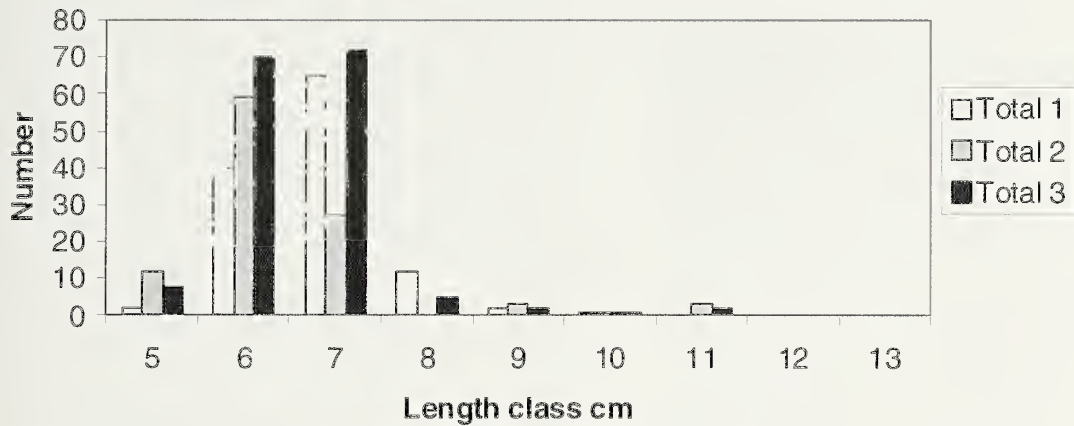
The size of elvers caught in 2006 and 2007 varied from 5cm up to a maximum of 11cm (Figure 3). The average size of elvers caught on day one (mean= 6.80 cm) was slightly higher than that (6.40 and 6.59cm) of elvers caught on the two following days ($F_{2,394} = 5.31$, $P < 0.01$). Similarly, the average size of fully pigmented elvers (mean = 7.57cm) was larger than that (5.58 and 6.44cm) of the other two colour forms ($F_{2,346} = 38.89$, $P < 0.001$). Empirical data are not available for the 2006 samples although mean lengths appeared to be higher for each of the four sampling sites (means 7.4, 8.0, 8.0 and 9.65 cm respectively) ($F_{3,134} = 15.95$, $P < 0.001$) than those recorded in 2007. The numbers of animals caught in the three colour ‘phases’ were 264, 23 and 56 respectively in 2007.

DISCUSSION

As far as we know there are no quantitative data available on the occurrence of elvers in any river or stream in Scotland although some data are available for ‘adult’ eel stocks in fresh waters (J. Godfrey personal communication). Elsewhere in Europe loss of eels appears to have been particularly severe in the elver catches (EA and CEFAS websites). For instance, values of CPUE for elvers sampled in Den Oever, the Netherlands have fallen from over 120 in the mid 1960s to less than 20 in the late 1990s. In the UK, values of CPUE are difficult to interpret as the unit of effort has increased to compensate for decline in catches.

In England and Wales the number of license applications for dip-nets fell from 2,500 in 1998 to 1,900 in 1999 reflecting reduced catches (E.A.Website). Recently (May 2008), the EA in association with the R.S.P.B. transferred 2000 elvers from the west coast of England to Minsmere on the east coast in an attempt to enhance eel stocks there. There is some evidence to suggest that eels are under-represented in easterly flowing rivers compared to those facing the main Gulf Stream. If successful, this could be a valuable conservation initiative.

a) Size distribution of elvers on three separate sampling occasions May 2007



b) Size distribution of three colour 'forms' of elvers, May 2007

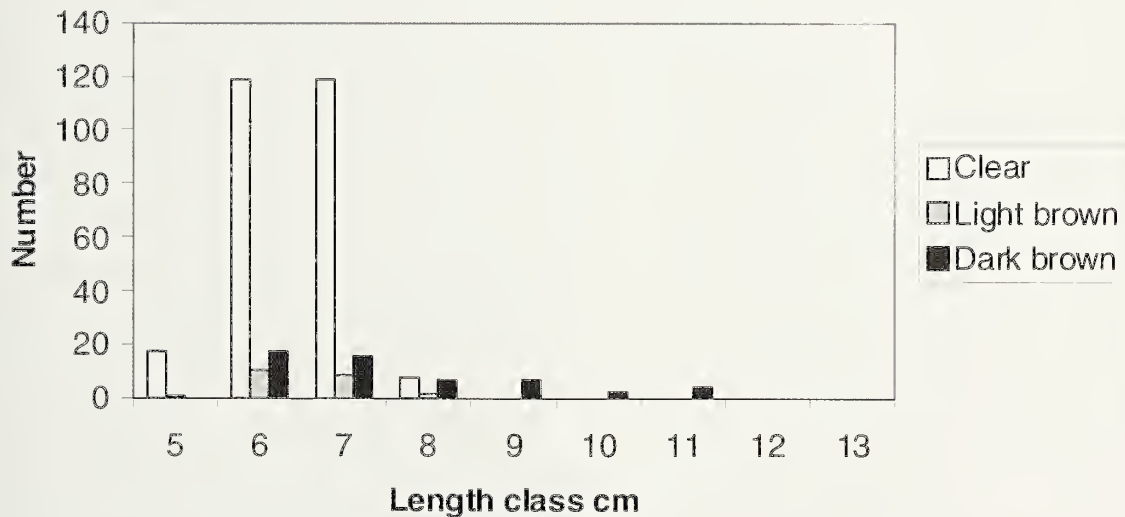


Fig. 3. Variation in the size of elvers caught in 2007 by a) day and by b) colour .

From our own cursory observations, elvers appeared to be widely dispersed across streams on the Ross of Mull in the spring (May) although we have not sampled them all in detail (C.Goldspink, own observations). Presumably, these elvers had moved northwards following the general flow of the Gulf Stream along the coastal regions. Although our sample sizes were trivial compared to catches taken in commercial fisheries, they do demonstrate that elvers are still present in 'significant' numbers in some of the coastal streams on the west coast of Scotland.

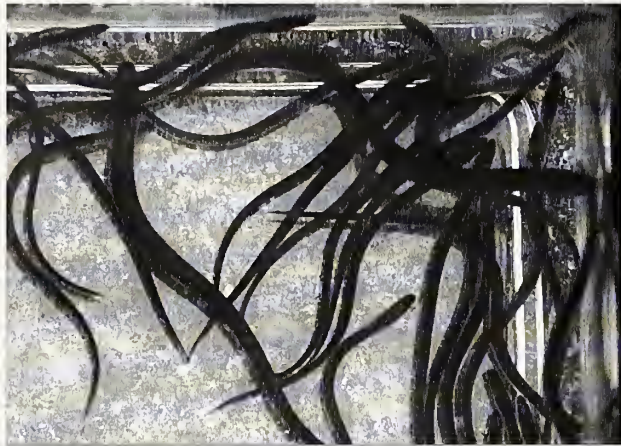


Fig. 4. Sample of elvers from the stream.

Catches remained high in 2007 even after the removal of animals over three days. This suggests that elvers had been stimulated to move upstream as a result of the flash flood then. The ultimate fate of these animals remains unknown but the area is not noted for the abundance of its freshwater invertebrates (C. Goldspink, unpublished). Herons *Ardea cinerea* were regularly seen feeding in the estuary and probably take significant numbers of elvers there. Nevertheless, given the current demise of eels in the UK and in Europe the methods used here could perhaps be more widely applied across the coastal regions of Scotland in other estuaries and streams. It would be an excellent exercise for school children if properly supervised. All elvers were caught within the sediments although some of the larger elvers had penetrated further upstream than the smaller transparent forms, although this observation was not pursued in detail. Some streams on the Ross of Mull are highly polluted with agricultural effluents which is not conducive to a sustainable migration and recruitment of elvers.

ACKNOWLEDGEMENTS

Useful discussions were held with Drs Jason Godfrey, Jim Treasurer, Gordon Copp and Koos Vijverberg during the preparation of this article. Michael Hoults kindly assisted in the production of Fig. 1. The manuscript was improved following comments from two anonymous referees.

ADDENDUM

The Fisheries Society of the British Isles is to publish a special issue in its journal entitled *Anguillid Eels* for publication in June 2009 which further addresses the current demise of the species group. www.fsbi.org.uk

A concise review of the status eels in England and recent management initiatives is available on the Environment Agency (EA) website <http://www.environment-agency.gov.uk/subjects/fish>

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